

THE MARIN COUNTYWIDE PLAN



**ENVIRONMENTAL
HAZARDS ELEMENT**

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ENVIRONMENTAL HAZARDS ELEMENT

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I. INTRODUCTION

Marin County is characterized by a diversity of natural and man-made features which results in a wide range of environmental hazards. For example, steep slopes underlain with unstable soils create landslide risks; low-lying areas are susceptible to floods; dam inundation areas span many square miles; and the San Andreas, Rodgers Creek, and San Geronimo faults are present in Marin.

Many of the policies in the Environmental Hazards Element have been successfully implemented since its adoption in 1977. A number of County agencies have programs for disaster mitigation and relief. These agencies include the County Office of Emergency Services, Public Works Department, Community Development Agency, and Fire Protection Districts.

The Countywide Plan focuses on minimizing the impact of an emergency situation through the implementation of policies and programs in the Environmental Hazards Element.

A. LEGAL AUTHORITY

The Environmental Hazards Element fulfills the requirement for a "safety element" as described in the California Government Code Section 65302(g). This Section states that the General Plan shall include:

A safety element for the protection of the community from any unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche, and dam failure; slope instability leading to mudslides and landslides, subsidence and other geologic hazards known to the legislative body; flooding; and wildland and urban fires. It shall also address evacuation routes, peakload water supply requirements, and minimum road widths and clearances around structures, as those items relate to identified fire and geologic hazards.

B. RELATIONSHIP TO OTHER GENERAL PLAN ELEMENTS

The Environmental Hazards Element is related to other elements in the following manner:

- *Community Development Element:* Designates land uses and densities in a manner which minimizes hazards to life and property.
- *Community Facilities Element:* Discusses provision of critical emergency services, such as fire, and peak load water supply.
- *Transportation Element:* Transportation facilities vital in the event of emergency, including: evacuation and access routes; transportation of supplies and equipment; public transportation used for post-emergency trips.

C. RELATIONSHIP TO OTHER GENERAL PLAN DOCUMENTS

This element is based on three technical report studies:

- Environmental Hazards Technical Report #1, Floods: Existing Conditions and Recent Studies
- Environmental Hazards Technical Report #2, Fire Hazards: Existing Conditions
- Environmental Hazards Technical Report #3, Seismic and Geologic Hazards in Marin County

Hazardous waste management hazards and mitigating policies and programs are detailed in the draft County Integrated Waste Management Plan. The Marin County Multihazard Plan (1988), prepared by the County Office of Emergency Services, coordinates actions of agencies in the event of a large-scale emergency. Necessary actions include establishment of command posts, evacuations, traffic control, transportation supplies and equipment, requests for mutual aid, public information including evacuation instructions and media announcements, and provisions for travel to return home.

D. ORGANIZATION OF THE ELEMENT

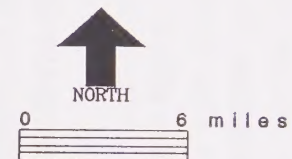
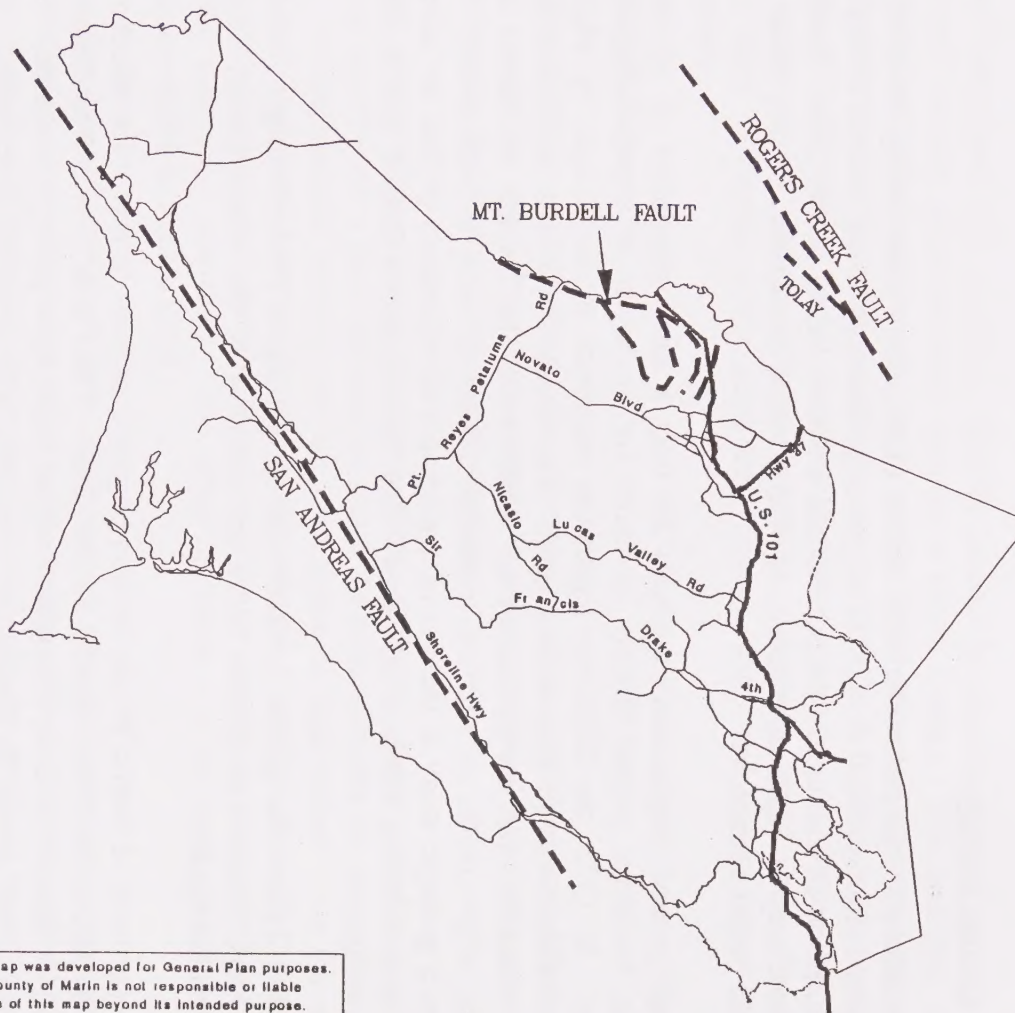
This element identifies potential environmental hazards which are a consideration in land use decisions: seismicity, geology, fire, and floods. The document text and figures describe existing conditions in the county under each of these four categories. The element's policies, objectives, and implementation programs are designed to mitigate potentially hazardous conditions.

II. EXISTING CONDITIONS

A. SEISMIC HAZARDS

The San Andreas Fault runs through the western portion of Marin County and is the only known active fault in the county (see Figure EII-1). Some geologic evidence indicates movement within the past 10,000 years on the Mount Burdell fault. The epicenter of the famous 1906 earthquake, estimated at a magnitude of 8.25 on the Richter scale, was in the vicinity of Olema in West Marin on the San Andreas Fault. Damage was severe along the fault zone where settlement and buildings were often concentrated, multi-storied, or located on alluvium. Near the head of Tomales Bay, ground displacement was reported to be approximately 21 feet.

Figure EH-1
Fault Traces in Marin County



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for use of this map beyond its intended purpose.



Seismic risk in Marin falls into four broad categories:

- Ground rupture and surface displacement
- Ground shaking
- Ground failure and related secondary effects
- Tsunami and seiche effects

The amount of damage sustained in an earthquake depends on the magnitude of the quake, location of the epicenter, geology of the area, and the amount and type of development in the area. Since the type and extent of damage varies, County policies must be tailored to local conditions.

1. Ground Rupture

For the most part, ground rupture and surface displacement occur during moderate to great earthquakes (Richter 5.3-7.7+). The length of ground rupture and amount of displacement are a function of earthquake magnitude and the total length of the fault. Surface fault movement may be rapid and sudden, as with a major earthquake, or may occur over an extended period of time.

Although ground displacement accounts for only a small percentage of all earthquake damage, buildings located directly on faults are in danger of experiencing significant damage. In 1972, the California legislature responded to this danger by adopting the Alquist-Priolo Geologic Hazard Zones Act. The Alquist-Priolo Act prohibits construction of new facilities for human occupancy which would be located on known traces of specified active faults, or within a minimum 50-foot distance of such traces. The Act requires a geologic study at the site of a proposed developments of four or more single-family houses falling within a fault zone. The 50-foot setback from a fault is determined by this study.

Figure EH-2 shows the general areas covered by the Alquist-Priolo Geologic Hazard Zones Act. Maps rendered in greater detail are available at the Marin County Community Development Agency.

The Department of Public Works reviews proposed projects to determine whether the site falls within an Alquist-Priolo Special Studies Zone. The Public Works Department has the authority to approve or deny a proposed project based upon geologic concerns. However, an applicant may appeal the Department's decision to the Board of Supervisors.

2. Ground Shaking

Ground shaking is the most significant factor contributing to human and economic loss, since shaking may trigger secondary hazards like fire and landslides.

It is important for a seismic risk evaluation to assess the geographic sphere and intensity of potential ground shaking. Unlike ground rupture, shaking can cause damage many miles from the fault. Figure EH-3 shows the maximum ground shaking intensity in Marin County and Figure EH-4 depicts the geologic units susceptible to ground shaking.

Evidence suggests that tall structures built on relatively soft saturated sediments experience the greatest damage from shaking. Structural integrity is a critical factor in assessing potential damage from shaking. Unreinforced masonry buildings are the construction type most susceptible to failure. More detailed information on the effect of an earthquake on different types of buildings can be found in the Environmental Hazards Technical Report #3, Seismic and Geologic Hazards in Marin County.

The County anticipates that secondary hazards caused by ground shaking in a major earthquake will actually cause the most damage to Marin County. For example, many streets traverse landslide deposits, and streets are the usual routes of underground utility lines. A landslide could block transportation routes, as well as rupture water, gas and sewer lines. Ground shaking could also cause highway overpasses to collapse, crippling important transportation routes. Damage to dams and levees could cause flooding, although a large earthquake could completely rupture dams and release most of the reservoir waters.

3. Ground Failure

Types of ground failure include liquefaction, lateral spreading, landslides, and differential settlement. Landslides and differential settlement can occur independent of an earthquake and are discussed in the Section II.B.1 of this element.

Liquefaction results when an earthquake transforms saturated, loose granular materials (silt, sand, or gravel) into a fluid-like state in which the solid particles are suspended, like quicksand. Water-saturated deposits are the most prone to liquefaction. On the other hand, clay is an important deterrent to liquefaction because it tends to bind sand together. Liquefaction-prone geologic materials, listed in order of decreasing susceptibility, are: artificial fill, sand, and alluvium. The areas in Marin County most susceptible to liquefaction are shown in Figure EH-5.

Lateral spreading is another type of ground failure which can be induced by an earthquake. Lateral spreading is caused by a loss of strength in fine-grained cohesive materials. It occurs most often in soft, saturated clays like bay mud. In the event of an earthquake, liquefaction and/or lateral spreading could weaken foundations, rendering bridges unsafe and overpasses unusable.

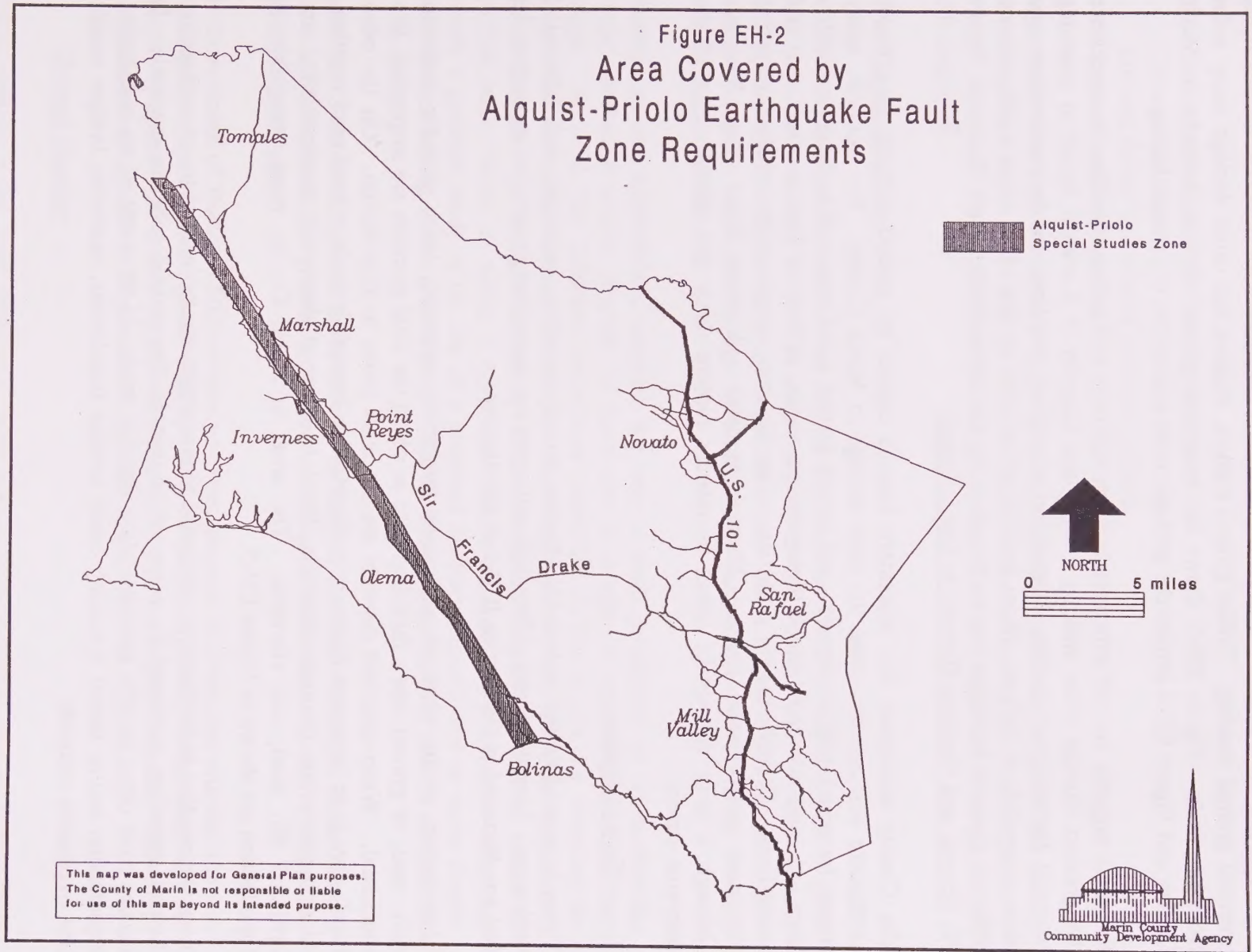


Figure EH-3
Maximum Ground Shaking Intensity

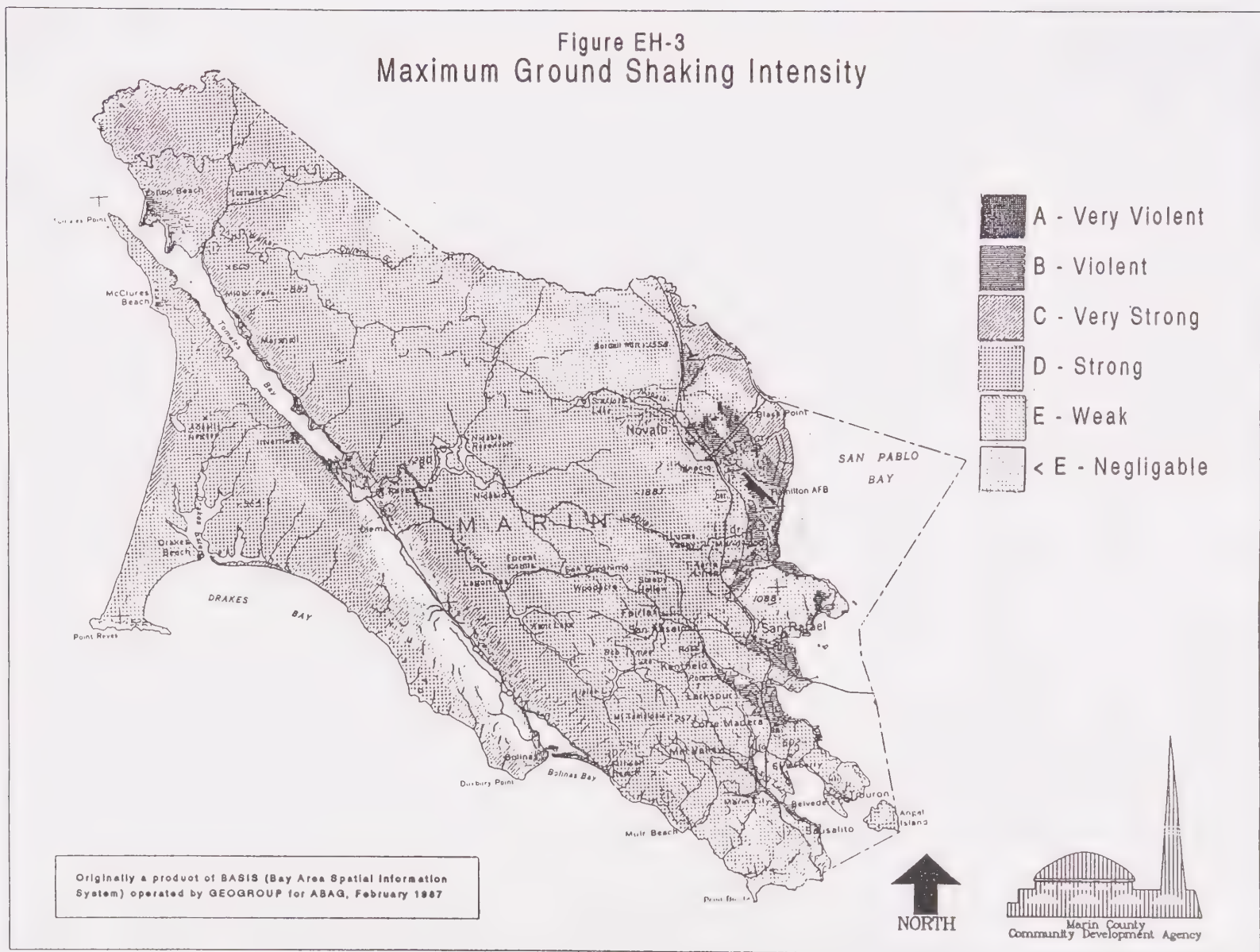
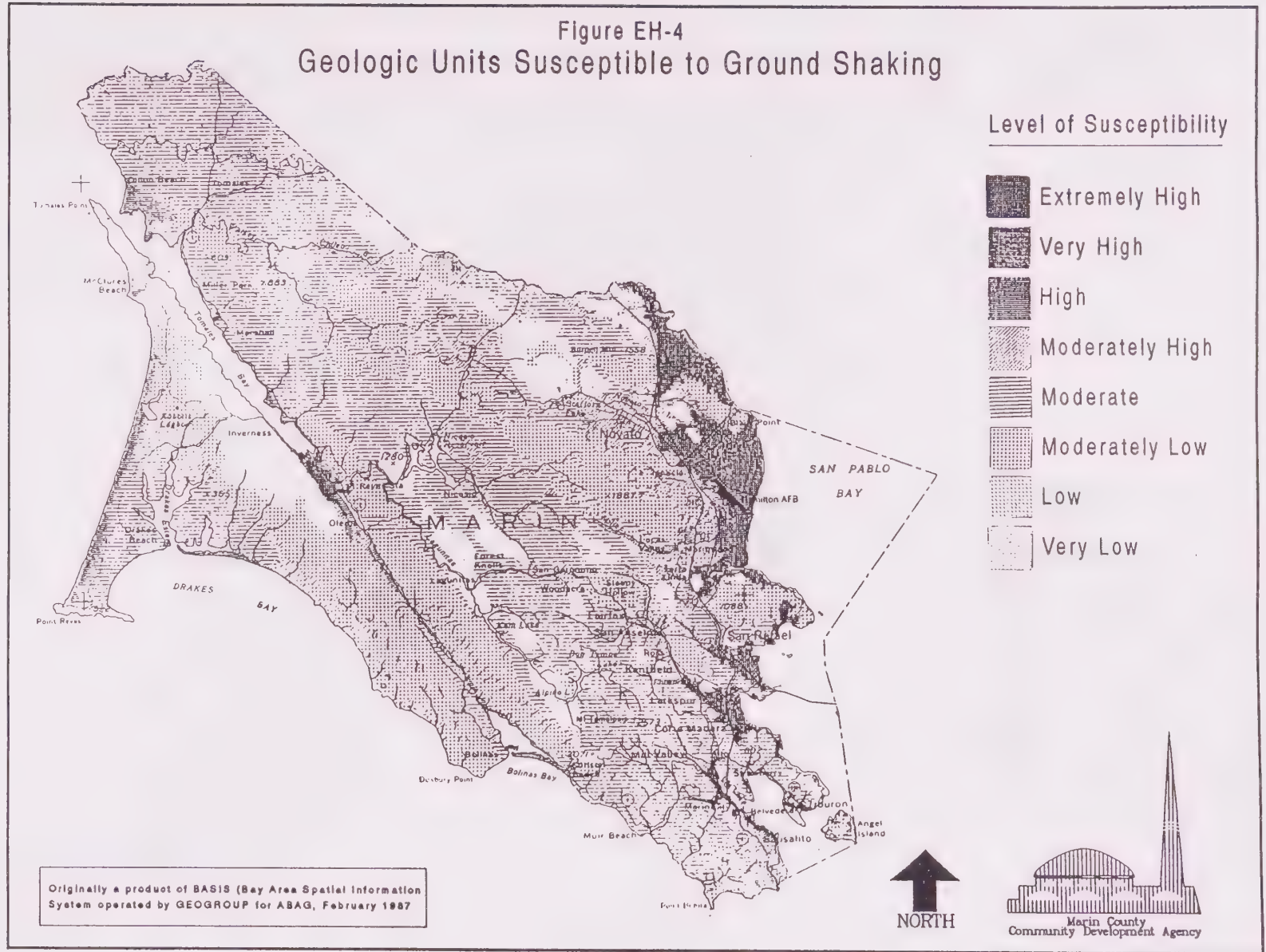


Figure EH-4
Geologic Units Susceptible to Ground Shaking



Earthquake-induced landslides generally occur in the same geologically unstable areas as landslides induced by other factors and may be indistinguishable from slides precipitated by other events. The energy of an earthquake can act as a catalyst for landslides on unstable soils and rock that might otherwise have been induced by a future rainy season or other event. Landslides in areas of low slope angles can result from liquefaction of subsurface sand layers during earthquakes.

4. Tsunami/Seiche

A tsunami is a large ocean wave generated by a seismic event in or near the ocean. Coastal floods from tsunami rarely occur along the Pacific Coast or in the San Francisco Bay. A 1964 tsunami, generated by an earthquake in Alaska, was the most recent tsunami to cause significant damage in the county. It resulted in damage to yacht harbors in San Rafael and Sausalito estimated at \$275,000.

A seiche is an earthquake-generated wave in an enclosed body of water, such as a lake or a reservoir. Seiche waves are generally less than a foot high. However, wave run-up can be as high as 20 or 30 feet in shallow or constricted areas. These high waves have the potential to overtop dams and reservoirs and flood downstream development. See Environmental Hazards Technical Report #1, Floods: Existing Conditions and Recent Studies for a more detailed discussion of tsunamis and seiches.

5. Legislation and Regulations

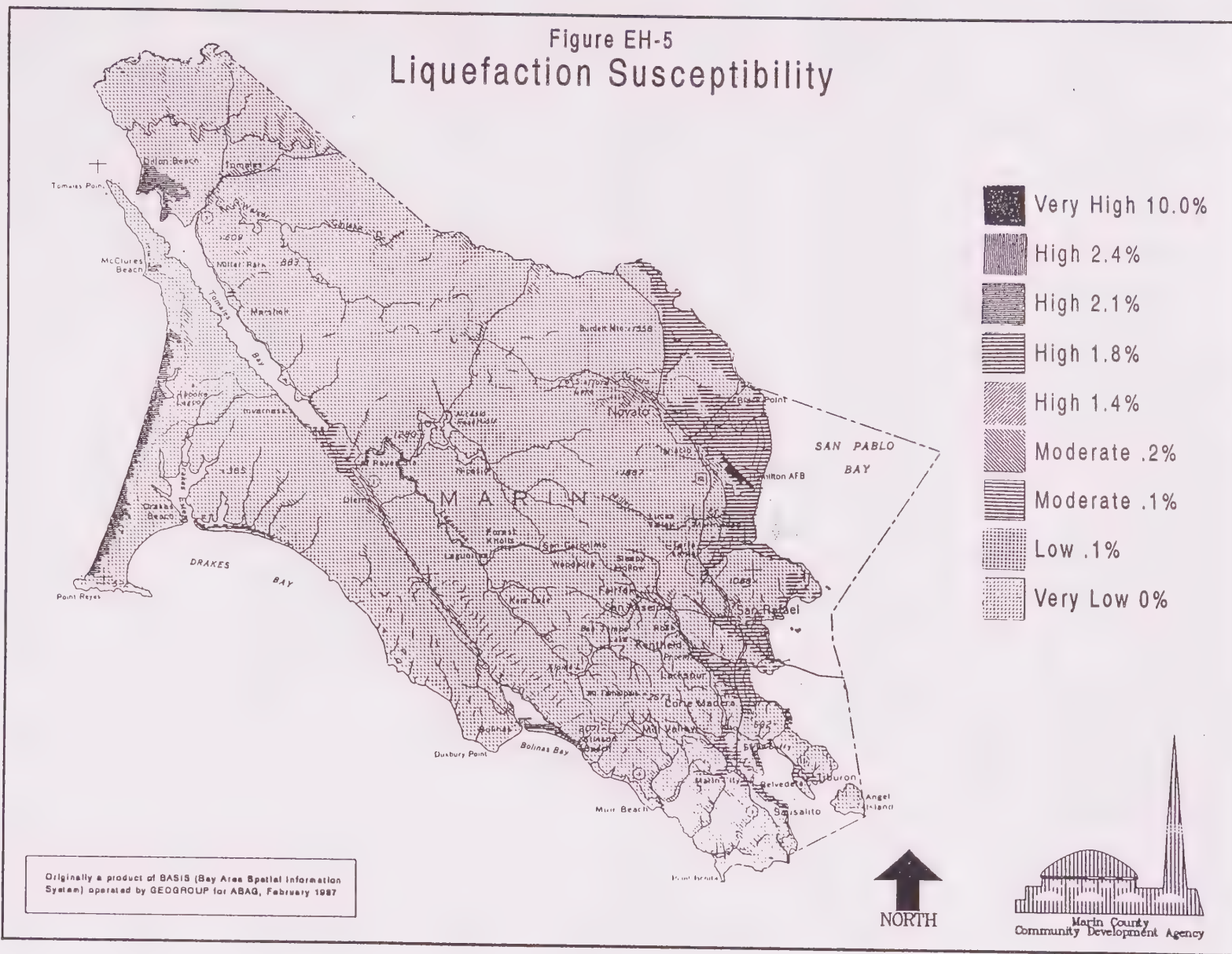
Special consideration must be given to the location of critical facilities, those facilities which need to remain operational after an earthquake. Examples of critical facilities include hospitals, fire stations, and communication facilities.

The Essential Services Buildings Seismic Safety Act of 1986 (Health and Safety Code Section 16000 et seq.) regulates the design and construction of new facilities. However, local regulations are necessary for specific locational criteria. Local regulations also govern the safety of existing critical facilities. Communities should assess the vulnerability of existing critical facilities in order to ensure that emergency operations can be carried out effectively.

The Alquist-Priolo Special Studies Zone Act addresses potential ground rupture hazards and is discussed in Section I.A.2 of this element.

SB 547 (Government Code 8876) is directed at reducing hazards in existing buildings. This legislation requires jurisdictions to prepare inventories of all unreinforced masonry buildings with corresponding mitigation measures by 1990. The unincorporated portion of Marin County only has one unreinforced masonry building, located in Point Reyes Station.

Figure EH-5
Liquefaction Susceptibility



In addition to the legislation discussed above, the Uniform Building Code contains construction standards which mitigate potential structural damage from earthquakes. The Field Act contains rigorous specifications for construction of public school buildings. See Technical Report #3, Seismic and Geologic Hazards in Marin County, for detailed information on the effects of earthquakes on different types of buildings.

B. GEOLOGIC HAZARDS

The two major types of geologic conditions in Marin County contribute to stability problems, even in the absence of a seismic event (see Figure EH-6). The county's steep hills and ridges are subject to landslides and downhill creep. The bay plains, marshlands and mud flats are subject to subsidence and differential settlement.

1. Landslides

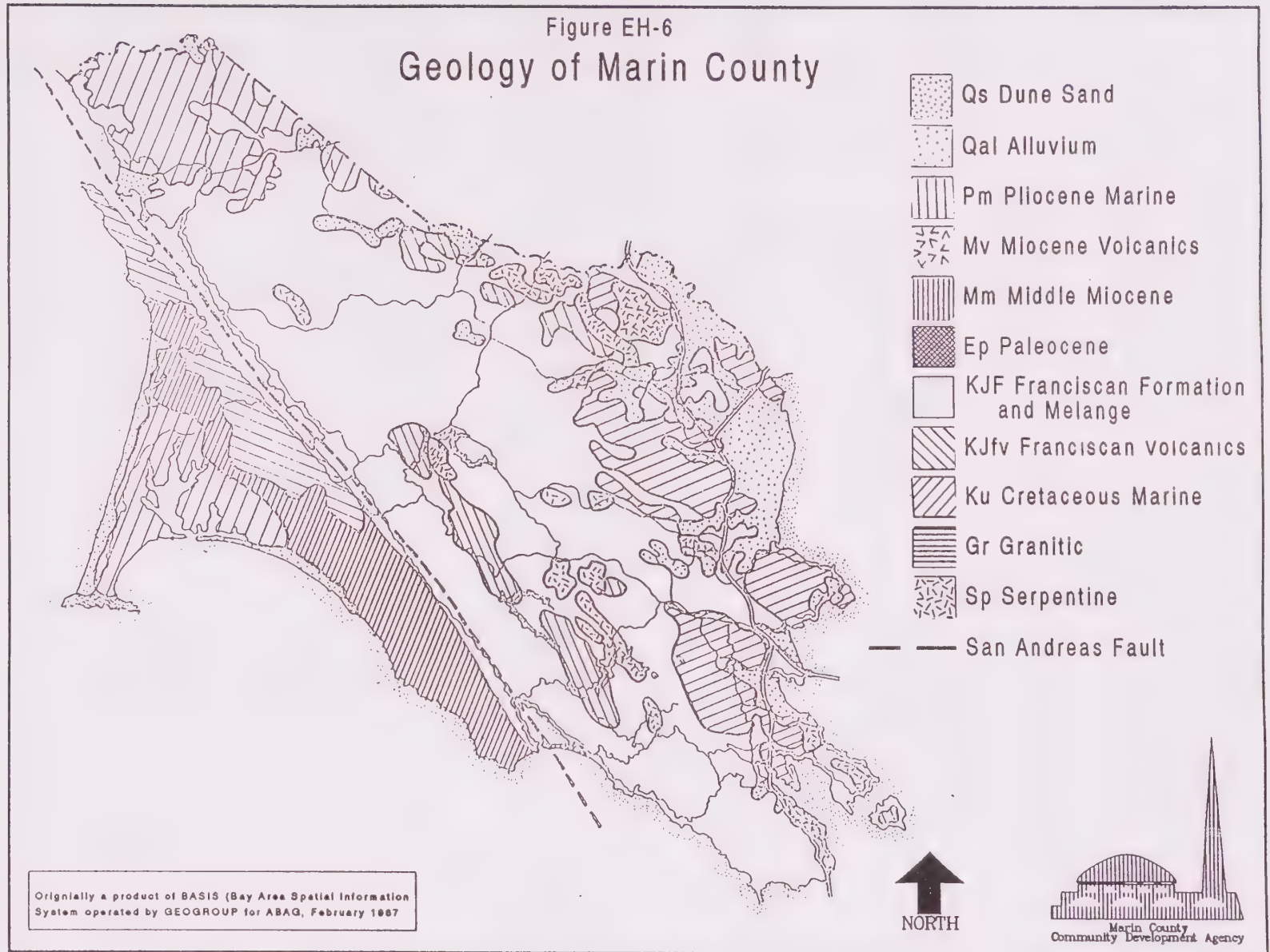
Landslides occur in certain areas for specific and relatively predictable reasons. The five primary factors determining slope stability are: 1) angle of slope; 2) soil characteristics; 3) degree of saturation; 4) human activity; and 5) seismic activity.

All steep slopes are not inherently unstable. However, a steep slope which is stable may become unstable as a result of cuts made for roads, homes, or other development. Characteristics of the soil also affect slope stability. Much of Marin County is underlain by Franciscan melange, a type of soil that is highly expansive and rich in clay. Moderately steep slopes underlain by such material often exhibit evidence of slow downhill creep or debris flow.

Soil saturation may occur during periods of heavy rainfall and as a result of domestic water use. Oversaturated soils tend to liquefy and flow rapidly downslope. Houses in Marin County have been damaged or destroyed when hit by fast moving flows and also when undermined by foundations embedded in liquefied soil. Human activities contributing to landslides include steep cuts in a slope, improper placement of fill on a slope, concentrated surface runoff, and irrigation practices.

All of the conditions discussed above would be exaggerated in the event of an earthquake. For this reason, it is critical that potential landslide hazards be examined by a geologist at the time of project development. Most landslide damage in Marin County has occurred within preexisting landslide deposits as a result of continuing or renewed movement. The majority of damaging landslides have occurred on slopes underlain by Franciscan melange.

In eastern Marin County, an extensive hazard and mapping project was undertaken by the California Division of Mines and Geology. These maps show land stability patterns and classify areas according to relative slope stability. The relative slope stability maps use the United States Geological Survey (U.S.G.S) maps as a base map. They are rendered at a scale of 1:12,000 or 1:24,000 and are available from the Marin County Community Development Agency.



The classifications of slope stability are described below:

- Zone 1**
Most Stable Includes resistant rock that is exposed or is covered only by shallow colluvium or soil. Also in this zone are broad, relatively level areas along the tops of ridges or in valley bottoms. These areas may be underlain by material that is weak (such as Franciscan melange matrix and alluvium), but occupies a relatively stable position. Some landslide deposits that have moved to relatively stable positions at or beyond the base of the slopes from which they were derived are in zone 1.
- Zone 2** Narrow ridge and spur crests underlain by relatively competent bedrock, but are flanked by steep, potentially unstable slopes.
- Zone 3** Areas where the steepness of the slopes approaches the stability limits of the underlying geological materials. Some landslide deposits that appear to have relatively more stable positions than those classified within zone 4 are also shown here.
- Zone 4**
Least Stable Includes most landslide deposits in upslope areas, whether presently active or not, and slopes on which there is substantial evidence of downslope creep of the surface materials. These areas should be considered naturally unstable and subject to potential failure even in the absence of human activities and influences. Banks along deeply incised streams are also included in zone 4.

The use of these slope stability maps is limited because of the large area involved and the widely varying conditions throughout the area. Despite these limitations, the maps provide an aid to land use planning and should be consulted when a proposed development is being considered. Property owners should consult with a qualified geologic engineer to determine the precise location of a specific property in the Slope Stability Zone.

2. Subsidence and Differential Settlement

Present and former marshlands and mudflats are particularly susceptible to subsidence and differential settlement. The bay mud in these areas is a soft, unconsolidated, water-saturated silty clay, containing peaty plant remains and mollusk shells. Developments built on filled bay marshlands and mud flats generally encounter stability problems. The continuing subsidence of fills results in intermittent flooding. Differential settlement damages structures, utilities, sewer lines, and roadways. These conditions create health and safety problems, as well as costly maintenance and repair problems.

In addition to the problems mentioned above, bay mud is highly compressible and subject to lateral flow when loads are placed on it. Ground shaking during an earthquake may trigger liquefaction.

Slope stability and subsidence (including liquefaction) pose a real threat to life and property in Marin County. Much of the danger associated with these geologic events can be avoided by careful evaluation of site conditions and implementation of proposed mitigation measures. In particular, critical facilities such as police and fire stations, hospitals, and communication centers must be placed outside of high risk areas.

C. FLOOD HAZARDS

A flood in Marin County could originate from watercourses, reservoirs, bay waters, and coastal waters. Human risks from flooding occur primarily in developed portions of the floodplain, areas of land which may be inundated from storm runoff, tidal action, or high surf.

Marin waterways regularly swell with storm water runoff and inundate developed areas. Portions of Mill Valley, Tiburon, San Rafael, Novato and the Ross Valley typically suffer annual flood damage. High tides combined with storm water runoff create floods in low-land bayfront and Pacific Coast communities. Flood hazards along the Marin coast may increase over time, due to the projected increase in the water level of the Pacific Ocean and San Francisco Bay. The county has eight major dams and many smaller dams. Each dam has the potential for failure and flooding of inhabited areas. Tsunamis and, to a lesser extent, seiches create flood risks.

It is important to avoid locating critical facilities in areas which may be subject to flooding, since these facilities must remain operational in an emergency situation. Location of critical facilities should be taken into consideration during project review and existing facilities should be identified and relocated whenever possible.

1. Watercourse Floods

A series of storms in 1982 caused highly destructive flooding in Marin. Overflowing streams turned streets in San Rafael, San Anselmo, Fairfax, Ross, and Kentfield into raging rivers. After the 1982 floods, Marin County was declared a State and Federal disaster area. The series of storms caused an estimated \$100 million in damage.

An approach to solving flood problems should focus on regulatory methods, rather than construction-related methods. Regulatory methods such as floodplain zoning and development standards are currently being utilized in Marin County. It is possible to target areas subject to flooding for uses which can withstand periodic inundation. Construction-related methods of flood control are discouraged because they may further alter the natural waterway system.

The Marin County Flood Control and Water Conservation District oversees flood control improvements and revenue collection in eight flood control zones (see Figure EH-7). Projects are recommended by individual advisory boards which report to the Board of

Supervisors. The Flood Control District has administered a number of flood protection measures including purchase of land, floodproofing of property, construction of berms and retaining walls, floodplain zoning, and major channel improvements.

2. Dam Inundation

Dams in Marin County are located near the San Andreas fault. In the event of an earthquake or after a major storm, the dams could rupture or spill water and cause flash flooding in populated areas. The severity of flooding depends on the size of the earthquake, amount of damage to dams, or the volume of water escaping from the dam.

The California Dam Safety Act of 1972 (SB 893) requires that the County plan for the sudden failure of a dam which could result in death or personal injury. The Act requires that areas of potential flooding from dam failure be identified on inundation maps. Procedures must be developed for emergency evacuation and control of populated areas within identified flood zones. Figure EH-8 shows areas subject to inundation, while more detailed maps are available through the Office of Emergency Services.

3. Coastal Water Floods: Ocean and Bay

The simultaneous occurrence of very high tides, large waves, storm swells, and rain could cause flooding along the Marin coast and the bay. In addition, a tsunami (discussed in EH II.A.5) could create potentially destructive water waves.

Strong southern winds accompanied by high tides and heavy surf threaten Pacific Coast and bayfront communities. Coastal communities most threatened by coastal water floods include Bolinas and Stinson Beach. In addition, areas along the San Francisco Bay near Novato Creek, the Petaluma River, Point San Quentin, San Pablo Bay, San Pedro Peninsula, and Sausalito face significant threat of flooding. The December 1983, February 1983, and February 1986 storms caused considerable damage in Marin County. In February 1983, a strong southern storm coupled with powerful winds and high tides flooded homes and businesses in San Rafael, Santa Venetia, and Stinson Beach. Pounding ocean waves destroyed five homes in Stinson Beach and damaged many others in the Seadrift area. High tidal waters poured over levees in San Rafael, flooding portions of East San Rafael. High tides also rushed through levees in Santa Venetia and flooded over 300 homes.

4. Rise in Sea Level

The projected rise in the water level of the San Francisco Bay, due to global warming, poses a flood hazard not addressed in the 1977 Environmental Hazards Element. The San Francisco Bay Conservation and Development Commission (BCDC) projects that the global climate change will raise the Earth's temperature. The higher temperature will melt ice caps and accelerate the sea level rise.

Figure EH-7
MARIN COUNTY
FLOOD CONTROL ZONES

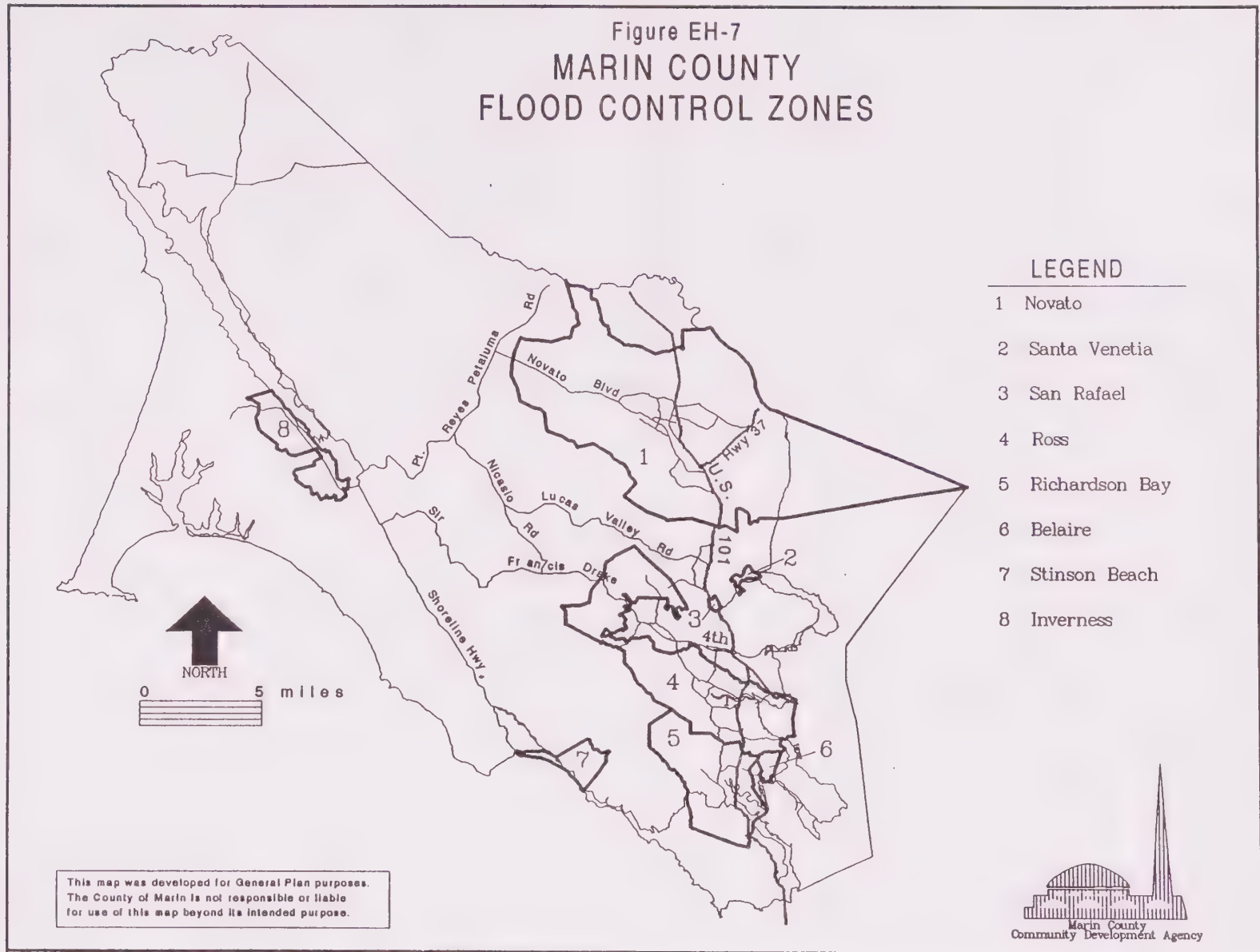
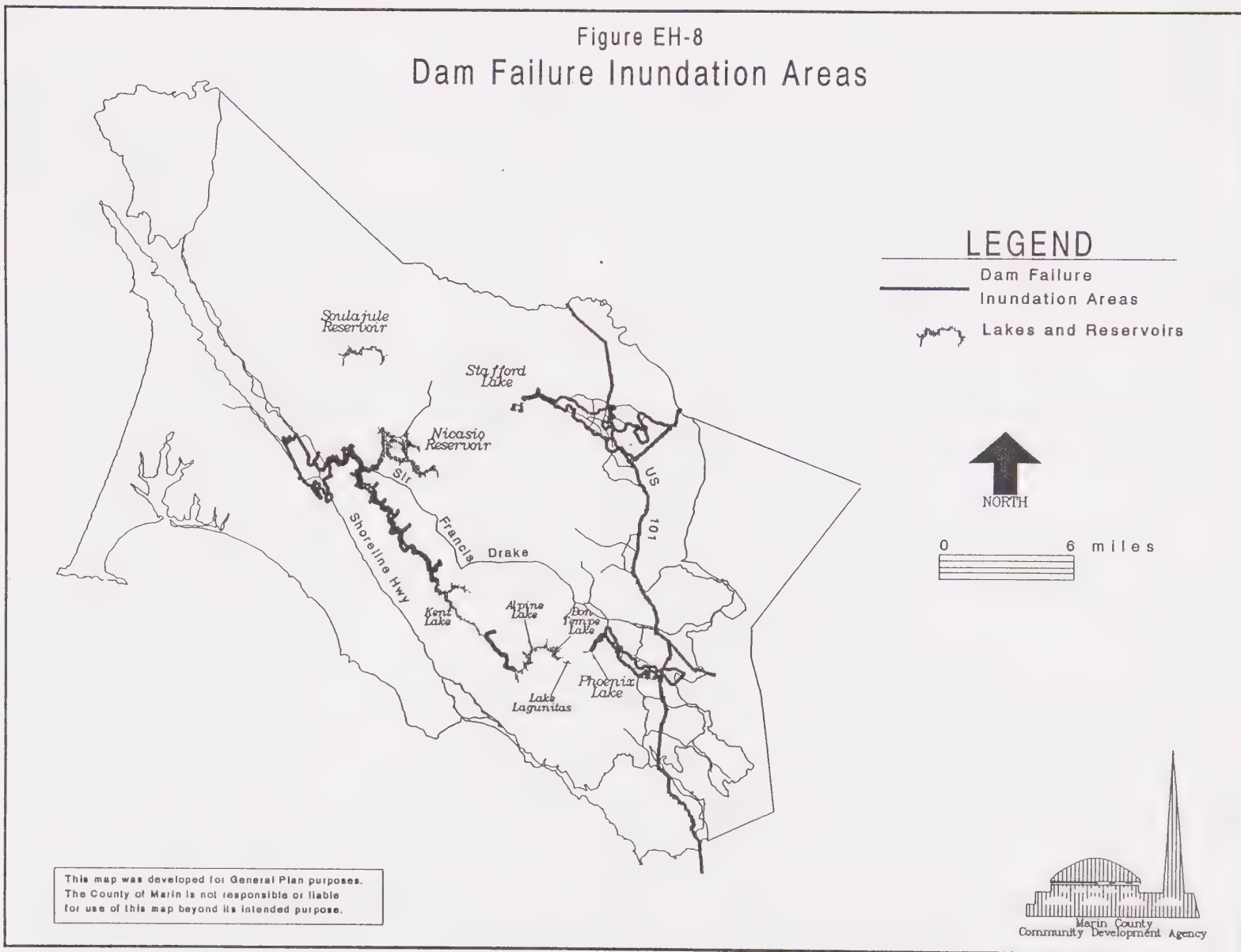


Figure EH-8
Dam Failure Inundation Areas



BCDC recommends that the possible rise in sea level should be taken into consideration in land use planning efforts and that areas at risk should be identified. More information is included in a report prepared for the San Francisco Bay Conservation and Development Commission, Future Sea Level Rise: Predictions and Implications for San Francisco Bay, (October, 1988).

D. FIRE HAZARDS

The eastern portion of Marin County and the West Marin communities of Bolinas, Inverness, and Stinson Beach are served by sixteen fire protection districts (See Figure EH-9). The State of California contracts with the County to provide protection to the "State Responsibility Area." This area includes most of the inland rural and coastal portions of the county and several communities, including: Homestead Valley, Kentfield, Lucas Valley, Marin City, Marinwood, portions of Santa Venetia, and Tamalpais Valley (shown in Figure EH-10).

Fire hazards in Marin County threaten lives, property, and the natural environment. Marin forest and chaparral areas which have been prevented from burning for as long as 40 years pose a significant hazard to scenic environments and residential communities. Many Marin homes face an increased fire risk due to factors such as steep slopes, narrow streets, flammable roofing materials, proximity to old and overgrown vegetation, and distance from fire stations.

Fire hazards in the County fall into two general categories: wildland fires and structural fires. Wildland fires emanate from open chaparral, grassland or forest areas and can threaten adjacent residential communities. Structural fires damage the home or the workplace and may spread to other areas.

1. Wildland Fires

Vegetation, weather, topography, and the location of built areas on the edge of wildlands are factors contributing to wildland fires in Marin County. Hot, dry summers reduce plant moisture and make vegetation more susceptible to burning. Winds influence fire direction and speed. Unpredictable winds near the ocean, along ridge lines and in steep drainages cause wildland fires to spread quickly and erratically. Steep slopes allow lowland fires to preheat vegetation before climbing hillsides, which increases the rate of fire spread and hinders firefighter access. Communities located in the urban fringe face risks in the event of a wildfire. These risks are increased by flammable building materials, stilt and pole construction along steep slopes, poor road access, confusing street addresses and dense vegetation immediately surrounding homes near the wildland.

A number of the policies and programs of this Element mitigate wildland fire hazards through a variety of vegetation management efforts. Public education is a priority of the Marin County Fire Department because the program encourages hazardous fuel reduction in existing developments. Policy EH-11.3 and its implementing programs and Policy EH-

11.5 require fire hazard mitigation new developments. While fuel management is a proven technique for mitigating wildland fire hazard, the controversial nature of Policy EH-11.6 Hazardous Vegetation has prevented the policy from being implemented. Policy EH-11.4 requires fuel breaks and access routes to aid in fire suppression efforts. Because state and local budget cuts have reduced fire prevention and suppression budgets, the County Fire Department recommended Program EH-11.1b, installation of residential sprinkler systems in all new structures and existing structures undergoing substantial remodeling. This recommendation was adopted by the Board of Supervisors.

The Marin Municipal Water District has a water reserve set aside for firefighting. The District has 100 pumping stations throughout the service area, five of which are gasoline-powered and could be used in the event of a power outage. Because many of the pumping stations are interdependent, if a pump at the bottom of a hill fails, the tanks further uphill can not be refilled. The District has no backup generators and has no plans to install backup generators (see the Community Facilities Element discussion of water supply). In the case of an earthquake/fire combination, water would probably not be available for either domestic use or for firefighting. Since most of the work crew of MMWD lives in Sonoma County, access problems in a state of emergency after business hours could prevent the work crew from reporting to duty.

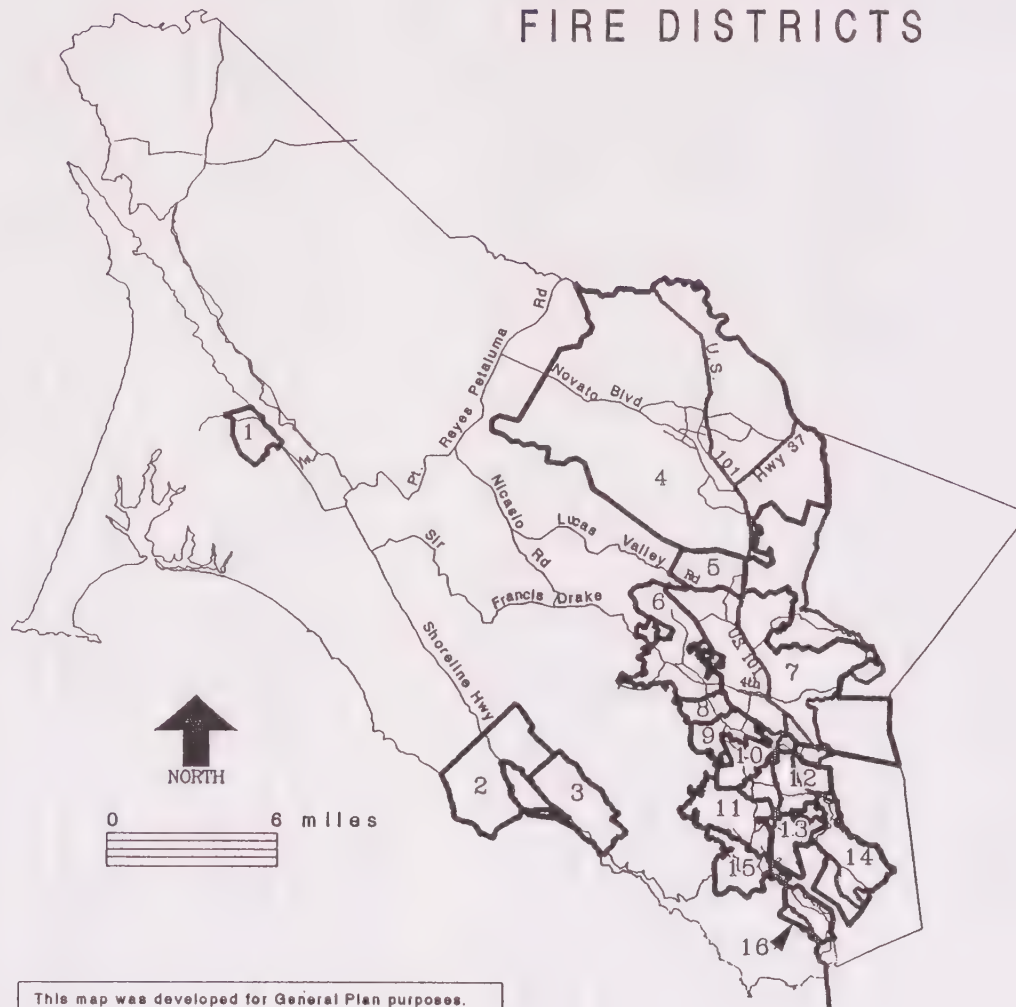
A major wildland fire in Marin could cause severe damage to open space and park lands. Land would be scarred by fire fighting techniques involving bulldozing, road cutting, and fire retardant chemicals. Rainfall following a major fire could cause severe erosion, landslides and mudslides. Landslides and mudslides might endanger roads and homes and would disrupt plant renewal by displacing topsoil. Residences located near forest, brush, or grassland areas are also threatened by wildland fires. Dry natural cover can set a home on fire during a major wildland fire and many of these homes are surrounded by trees and brush.

2. Structural Fires

Risk of structural fires exists for all buildings, including homes, businesses, and recreational facilities. Between 1978 and 1986, structural fires in the County caused \$23 million in structural damage and \$10 million in content damage to homes. These fires also injured 179 people and caused 16 deaths.

Lack of adequate water supply for fire fighting, poor access to structures, and delayed emergency response may increase fire losses. A survey of fire departments in the County (1987), found an increased risk of loss from structural fires in Marin unincorporated areas. The existing conditions which cause this high risk of loss include: 1) long response time; 2) inadequate road access; and 3) poor water supply.

Figure EH-9
MARIN COUNTY
FIRE DISTRICTS



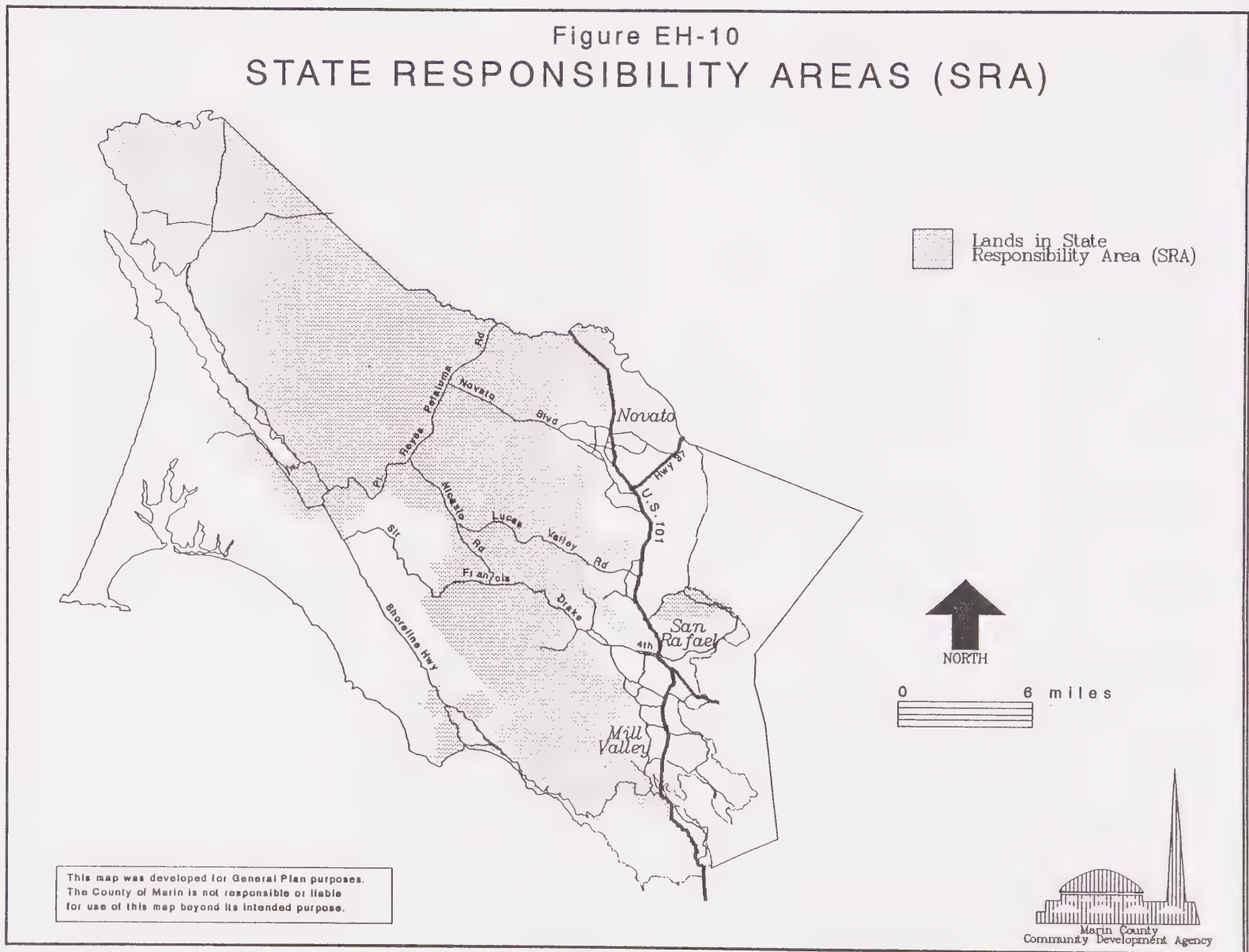
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LEGEND

- 1 Inverness Public Utilities District
- 2 Bolinas Fire Protection District
- 3 Stinson Beach Fire Protection District
- 4 Novato Fire Protection District
- 5 Marinwood Community Services District
- 6 Ross Valley Fire Department
- 7 San Rafael Fire Department
- 8 Ross Fire Department
- 9 Kentfield Fire Protection District
- 10 Larkspur Fire Department
- 11 Mill Valley Fire Department
- 12 Corte Madera Fire Department
- 13 Alto-Richardson Bay Fire Protection District
- 14 Tiburon Fire Protection District
- 15 Tamalpais Fire Protection District
- 16 Sausalito Fire Department



Figure EH-10
STATE RESPONSIBILITY AREAS (SRA)

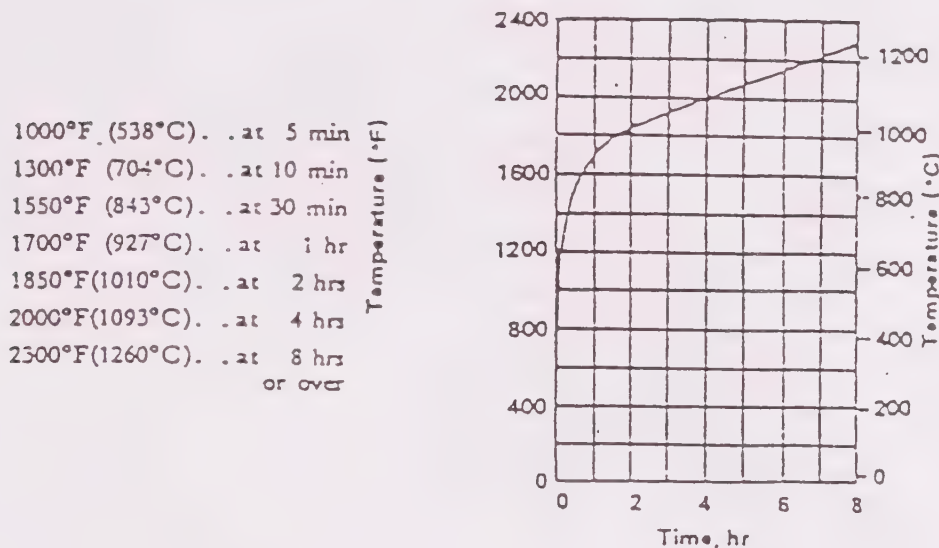


3. Fire Construction Standards

Fire safety construction requirements vary according to the response time of fire services, accessibility of a location, and availability of water. The critical response time for a structural fire is five minutes, since temperatures reach a level sufficient to cause significant damage within five minutes of the outbreak. Temperatures high enough to ignite most interior materials are (See Figure EH-11): wood at 508° F; cotton at 410° F; and synthetic fiber at 600° F.

In Marin County, fire construction standards vary between jurisdictions and fire protection areas (see Technical Report # 1, Community Facilities for a list of each jurisdiction's requirements). In State Responsibility Areas, the State Fire Marshall may define fire hazard zones and apply special construction standards, like fire retardant roofs. Outside of the State Responsibility Area, fire districts often recommend that fire retardant roofing be required as a condition of approval for discretionary projects.

Figure EH-11. The Time Temperature Curve



Source: National Fire Protection Agency, Building Construction Materials, 1985.

Fire safety requirements are not uniformly applied throughout the county because conditions and response times vary throughout the county. Upon review of individual development applications, local fire officials may find it necessary to apply requirements beyond those in local government codes. Discretionary applications for developments in

unincorporated areas are submitted to the appropriate fire district for review and comment. The Community Development Agency may need to apply conditions of approval based on the District's recommendations in order to protect the safety and welfare of the community.

For a non-discretionary permit, such as a permit for a single-family home on an existing lot, the Uniform Building Code and Uniform Fire Code determine the regulations for fire safety. These regulations are generally less strict than requirements recommended by the various fire districts.

III. OBJECTIVES, POLICIES, AND IMPLEMENTATION PROGRAMS

Objective EH-1. Public Awareness. To stimulate public awareness of environmental hazards.

Policy EH-1.1 **Support for Public Awareness.** The County should advise citizens on the availability of countywide and local area environmental hazards studies, sources of hazard information, and public services.

Program EH-1.1a Public Information. The County should prepare a handout informing prospective property owners about safety hazards that may exist on properties within Marin County. This document could be distributed by members of the Marin Association of Realtors to prospective and existing Marin residents.

Program EH-1.1b Maps Available. Maps depicting the areas covered by the Alquist-Priolo Special Studies Zone Act should be made publicly available at County offices and the County Community Development Agency.

Program EH-1.1c Improve Soils Information. The County should develop a systematic and accessible compilation of existing drilling log data in filled and bay mud areas.

Policy EH-1.2 **Support Scientific Geologic Investigations.** The County should continue to support scientific geologic investigations which refine, enlarge and improve the body of knowledge on active fault zones, unstable areas, severe ground shaking, and similar hazardous conditions in Marin County.

Objective EH-2. Location and Rehabilitation of Public Structures. To protect public health and safety through safe location and rehabilitation of public structures.

Policy EH-2.1 **Location of Public Structures.** Structures necessary for the protection of public safety and/or the provision of emergency services should not be located in areas subject to inundation, subsidence, slope failure, or ground failure in a seismic event. An exception to this policy may be granted if the only alternative location would be so distant as to jeopardize the safety of the community, given that adequate precautions are taken to protect the facility.

- Program EH-2.1a** Project Review Procedures. The County Community Development Agency shall facilitate project review by providing reference maps on seismic study areas. Public structures shall be located outside such study areas.
- Policy EH-2.2** **Emergency Building Design.** Emergency buildings and vital utilities, communication systems, streets and other public facilities should be designed in a manner which allows them to remain operational during and after an earthquake, or any other disaster.
- Policy EH-2.3** **Critical Facilities.** Within designated fault zones, the following critical public uses should be prohibited: schools, hospitals, utility and public safety facilities, high density housing and reservoirs.
- Objective EH-3. Minimize Construction Hazards.** To minimize hazards to the public from private construction located in hazardous areas.
- Policy EH-3.1** **Location of Future Development.** New development shall be sited in a manner which avoids or minimizes the potential of hazards from earthquake, erosion, landslides, floods and fire. Development should not be endangered by nor contribute to hazardous conditions on the site or on adjoining properties.
- Program EH-3.1a** Project Review. The Community Development Agency shall continue to review the impact of a project on the site and surrounding properties potentially affected by the development.
- Policy EH-3.2** **New Development Approval.** New development will be approved in identified geologic hazard areas only if the hazards can be reduced to acceptable levels through mitigation measures which are appropriate to the site, and consistent with other policies in the Countywide Plan.
- Program EH-3.2a** Mitigation. The County Community Development Agency should continue to require mitigation measures for projects proposed in areas with identified geologic hazards.
- Policy EH-3.3** **Disaster Protection Measures.** At places of employment, residence, and public gatherings, safety measures shall be taken to protect the public health and safety during and following a disaster. These measures shall include provisions for the health and safety of people with disabilities.

Program EH-3.3a

Project Review. Criteria for project review should provide for the health and safety of members of the public.

Objective EH-4. Protection from Ground Rupture Hazards. To protect public health and safety from ground rupture hazards.

Policy EH-4.1

Alquist-Priolo Special Study Zones. The Alquist-Priolo Special Studies Zone Act shall continue to be implemented by the County and efforts should be made to inform applicants early in the development process of the existence of known fault traces which might affect their property, site development, and design.

Policy EH-4.2

Location of Structures. No public or private structure built for human occupancy, or with the potential to imperil structures built for human occupancy, shall be permitted to be placed across the trace of a confirmed active fault. This policy shall not be interpreted as being more restrictive of single-family residential construction than the Alquist-Priolo Act. It is assumed that the area within fifty (50) feet of an active fault is underlain by active branches of that fault unless and until proven otherwise by an appropriate geologic investigation.

Program EH-4.2a

Project Review Procedures. The Department of Public Works should continue to determine the applicability of the Alquist-Priolo Act, and if necessary, require a site investigation report by a registered geologist.

Policy EH-4.3

Public Financing Support. Public financing or support should be withheld from buildings located in an Alquist-Priolo Special Studies Zone with a confirmed fault trace, unless there is no possibility of surface fault displacement or ground rupture which would injure the public investment.

Policy EH-4.4

Geologic Investigation Requirement. No new building sites should be created within the Alquist-Priolo Special Studies Zone, unless an appropriate geologic investigation establishes sufficient and suitable land area for development according to existing zoning and other applicable County ordinances.

Program EH-4.4a

Applications for Development. Applicants proposing to develop land or divide land into two or more parcels located within the Alquist-Priolo Special Studies Zone must submit a geologic report to the County. The report shall be prepared by an engineering geologist and directed to the problem of

potential surface fault displacement through the project site unless a waiver has been approved by the State Geologist.

Objective EH-5. Protection from Ground Shaking Hazards. To protect public health and safety from seismic ground shaking hazards.

Policy EH-5.1 **Mitigation of Risk.** Construction of all new habitable structures, including those for residential, commercial, and industrial use, shall employ engineering measures which mitigate against life safety risks from ground shaking. At minimum, new structures shall meet standards specified in Title 19, Marin County Code.

Policy EH-5.2 **Geotechnical Investigation Requirements.** Applications for proposed developments sited on landslide deposits, non-engineered fill, or bay mud shall be accompanied by a geotechnical engineering investigation which focuses on the problem of ground shaking and ground failure.

Program EH-5.2a Requirements for Soils and Geologic Reports. The Community Development Agency shall require that soils and geologic reports be submitted with master plan applications, and that soils and/or geologic reports accompany subdivision applications.

Policy EH-5.3 **Potential Earthquake Hazard in Existing Buildings.** The County should minimize potential earthquake damage from existing publicly owned buildings through strengthening building structure, eliminating hazardous features, or relocating buildings.

Program EH-5.3a Structural Improvements. The Department of Public Works should identify structural improvements needed for safety in public buildings and develop measures to institute the necessary improvements.

Program EH-5.3b Compliance with SB 547. In compliance with SB 547, the Department of Public Works should identify unreinforced masonry buildings in unincorporated county areas and require strengthening of structurally unsound buildings.

Policy EH-5.4 **Location and Design of High-Occupancy Structures.** The design and siting of structures occupied by a large number of people, such as restaurants and hotels, shall consider site constraints. Site constraints and appropriate safety measures

for design and siting shall be determined by the engineering geologist and civil engineer conducting the site investigation.

Program EH-5.4a

High Density Structures. The Department of Public Works should determine that structures which are to be occupied by a large number of people (as described in Policy EH-5.4) are designed to be as safe as similar structures in locations not subject to excessive ground shaking or other geologic hazard.

Objective EH-6. Protection from Slope Instability and Landslide Hazards. To protect public health and safety from slope instability and landslide hazards.

Policy EH-6.1

Evaluate Projects in Stability Zones 3 or 4. Prior to consideration of site design or use, the Department of Public Works shall evaluate projects proposed in zones 3 or 4 (see EH II.B.1) in stability and landslide potential according to the California Division of Mines and Geology Classification 9. Project proposals shall be accompanied by a report prepared by a civil engineer with soils engineering expertise or a soils certified engineering geologist. The soils evaluation should address the structural foundation engineering of the actual site, the impact of the project on adjacent lands, and impacts of off-site conditions on the site. Project applicants may need to consult with a soils engineer to determine whether their parcel falls within Stability Zones 3 or 4.

Policy EH-6.2

Construction Observation and Certification. For work undertaken to correct slope instability, the County should require that the work is supervised and certified by a geotechnical engineer and, when necessary, an engineering geologist.

Policy EH-6.3

Projects on Known Landslides and Landslide-Prone Deposits. New development should not occur on known landslides and landslide-prone deposits on steep slopes, except where an engineering geologic site investigation indicates that such sites are stable, or can be made stable through appropriate mitigation measures. In such cases, it must be shown that the risk to persons, property, or public liability can be minimized to a degree acceptable to the County.

Program EH-6.3a

Project Review. The County should continue project review procedures which may require soils and/or geologic reports to be reviewed by the Department of Public Works.

Objective EH-7. Protection from Subsidence and Differential Settlement Hazards. To protect public health and safety from subsidence and differential settlement hazards.

Policy EH-7.1 **Filled Land Underlain by Compressible Materials.** Soils investigations for projects on filled land underlain by compressible materials (bay mud, marsh, slough) should delineate those areas where settlement will be greatest and subsidence may occur. Soils investigations should include: recommended site preparation techniques employed to preclude hazard; borings; identification of former sloughs; and a list of other factors which would accentuate differential settlement.

Policy EH-7.2 **Minimize Differential Settlement.** In the areas with great potential for differential settlement, uses should be planned which would not be damaged by settlement and which would provide minimum inducement to settlement that is detrimental to persons, property and public investment.

Program EH-7.2a **Soils Report Requirement.** The County shall continue to address differential settlement and subsidence in required geologic reports.

Program EH-7.2b **Findings Requirement.** The Public Works staff must make a finding that the proposed fill, excavation, or grading will not unduly or unnecessarily create a safety hazard in areas susceptible to differential settlement. The staff finding may be appealed to the Planning Commission.

Program EH-7.2c **Site Preparation Requirements.** When recommended by the consulting geotechnical engineer, site preparation shall include settlement monitoring for a period of time sufficient for evaluating the particular site characteristics as needed for detailed foundation engineering and site planning.

Policy EH-7.3 **Structural Design of Foundations and Utilities.** The structural design of foundations and utilities shall recognize the potential for differential settlement and subsidence.

Program EH-7.3a **Enforce Development Standards.** The Department of Public Works should continue to enforce development standards with regard to minimum elevations and ultimate settlement. The Building Inspection Department should continue to enforce building code requirements for structural design of foundations and utilities.

- Program EH 7.3b Augmented Expertise. The Department of Public Works should continue to hire consultants in soils engineering as necessary for evaluating specific developments proposed on bay mud and fill.
- Policy EH-7.4 **Identify Inadequately Engineered Fills.** The Department of Public Works should continue to determine the adequacy of engineered fills prior to the construction of structures.
- Objective EH-8. **Safety from Inundation.** To assure public safety in areas subject to inundation.
- Policy EH-8.1 **Location of Critical Facilities.** Public safety structures should not be located within the range of a tsunami.
- Program EH-8.1a Review Procedures. The County should utilize the California Environmental Quality Act environmental review procedure to review and direct the siting of critical facilities structures in tsunami hazard areas.
- Policy EH-8.2 **Construction.** Improvements should be designed to withstand impact from a tsunami and the debris it will carry. Structural features which could become dislodged or detached (docks, decking, floats, vessels) should be situated where they do not have the potential of becoming potential implements of destruction.
- Program EH-8.2a Implementing Regulations. The County shall continue to implement the regulations of Marin County Code Title 23.09 (Floodplain Management), which establishes Coastal High Hazard Zones with special locational and construction standards for all land uses subject to inundation by a tsunami.
- Policy EH-8.3 **Multiple Use.** The County should continue to promote the multiple use of areas set aside for flood retention ponding purposes (i.e. agriculture, open space, education, ecology), provided these uses can tolerate occasional flooding.
- Program EH-8.3a Application Review. The County should encourage the multiple use of ponding and encroachment areas designated under Title 23 (Floodplain Management). Through the application review process, the County should also encourage the use of lands reserved for floodplains under the Floodway Zoning provisions of Title 22 (Zoning).

Policy EH-8.4

Regulatory Methods of Flood Control. The County should encourage regulatory methods of flood control, rather than construction-related methods of flood control. Regulatory methods reduce the need for flood control projects, minimize losses in areas where flooding is inevitable, and ensure that those who occupy flood hazard areas are aware of the risks and assume responsibility for their actions.

Program EH-8.4a

Flood Hazard Zone Policies and County Code Provisions. The County shall continue to support and enforce policies in the Marin County Code pertaining to special flood hazard zones, including the Coastal High Hazard Zone (Title 23, Floodplain Management), the Bayfront, Floodplain, Tidelands, and Coastal Zones, Title 11 (Watercourse Obstruction), Title 22 (Floodplain Districts), and the provisions of Title 20 (Subdivisions).

Program EH-8.4b

Clarify Zoning Ordinance. The County Community Development Agency should strengthen and clarify references to flood hazard areas occurring along the San Francisco Bay, Tomales Bay, and the Pacific Ocean in the zoning ordinance sections pertaining to the Bayfront Conservation Zone, the Coastal Zone, the Planned District Zones, and the Tidelands Zone.

Program EH-8.4c

Refer Applications. The County Community Development Agency shall continue to refer all permit applications for proposed construction, substantial improvements and other development to the Department of Public Works to determine whether development is proposed within flood prone areas and therefore subject to the provisions of Title 23.09 (Floodplain Management).

Program EH-8.4d

Restrict Dangerous Uses. The County shall enforce the special location, storage, water supply, sewer, subdivision, and mobile home standards for flood hazard areas identified in Title 23 (Floodplain Management). Title 23 restricts uses which are dangerous to health, safety, and property due to erosion hazards, increases in flood heights or velocities.

Program EH-8.4e

Apply Construction Standards. The County Community Development Agency shall require that uses vulnerable to floods, including facilities which serve these uses, are protected against flood damage at the time of construction. The

construction standards of the Marin County Code, including Title 23 (Floodplain Management) shall be applied to protect these uses from flood damage.

Program EH-8.4f

Restrictions in Floodways. The County should support special restrictions in floodways and watercourses. Developments in floodways risk damage from erosion, high velocity flood waters, and potential projectiles from debris carried in the flood waters. Restrictions should prohibit encroachments in watercourses, prohibiting structures within a primary floodway, and restricting development in a secondary floodway or flood fringe which would increase risks to public health and safety in the event of a flood.

Policy EH-8.5

Zoning Overlays. To minimize flooding hazards, the County should expand the use of floodplain zoning overlays in flood areas.

Policy EH-8.6

Flood Runoff. The County should ensure that capacity is maintained in stream channels. The preferred measures for maintaining capacity are: regulating development; and whenever feasible, storing, ponding, or maintenance dredging. The County should control filling, grading, dredging, and other development which may increase flood damage by increasing sedimentation in streams and watercourses and increasing the amount of impervious surface in an area.

Program EH-8.6a

Enforcing County Codes. The County shall continue to enforce the provisions of Titles 11, 19, 20, 22 and 23, regarding grading, excavation, filling, and dredging.

Program EH-8.6b

Hydrologic and Geologic Studies. The County should require detailed hydrologic and geologic studies in development projects which have the potential for increasing sedimentation of watercourses, increasing impervious surface, or altering natural drainage patterns in order to insure adequate capacity for the safe handling of flood runoff.

Program EH-8.6c

Reevaluate Flood Prone Areas. The County should reevaluate flood prone areas, periodically regarding changes to elevations as a result of off-site development or natural forces.

Policy EH-8.7

Flood Barriers. The County should prevent the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards in other areas.

Objective EH-9. Protection from Dam Failure or Seiche. To protect the public from the consequences of a dam failure, or inundation from a seiche in the event of an earthquake.

Policy EH-9.1 **Dam and Levee Design.** The design and location of dams and levees shall be in accordance with all applicable design standards and specifications and accepted state of the art design and construction practices.

Program EH-9.1a Enforce County Code. The County shall continue to enforce the provisions of Title 11.04 (Dams) and Title 23.08 (Excavation) which allow the County to review applications for dam permits when the dam size is smaller than the minimum size requiring a permit from the State of California.

Program EH-9.1b Inspect Levees. The County should continue to review new levees for seismic and hydrologic safety.

Policy EH-9.2 **Notify Property Owners.** Property owners who are located in areas of possible inundation from failure at one of eight major dams should be notified regarding susceptibility to flood hazard.

Program EH-9.2a Public Information Regarding Dam Inundation Areas. Information on the location of dam inundation areas, for the eight major dams, should be made publicly available in the County Community Development Agency.

Objective EH-10. Minimize Hazards from Sea Level Rise. To minimize the effects of potential flooding due to the projected rise in sea level.

Policy EH-10.1 **Rise in Ocean Level.** The County will consider the potential for a sea level rise when processing development applications that might be affected by such a rise.

Program EH-10.1a Modify Construction Standards. The County Community Development Agency should work with the County Flood Control and Water Conservation District and Department of Public Works to prepare a plan for responding to a potential rise in the sea level. The County should consider developing flood control projects and modifying the Marin County Code Chapters 11, 22, and 23 to include construction standards for areas subject to increased flooding from a rise in the sea level.

Program EH-10.1b Monitoring Stations. The County should cooperate with the United States Geological Survey, the San Francisco Bay Conservation and Development Commission, and other agencies that establish monitoring stations to track the rise in Bay and ocean water levels .

Objective EH 11. Minimize Risk of Wildland and Structural Fires. To minimize the risk of wildland and structural fires, and ensure adequate fire protection.

Policy EH-11.1 **Fire Hazards.** The County should have information available on extreme fire hazard areas.

Program EH-11.1a Maps for Public Review. The County Community Development Agency should coordinate with the County Fire Marshall in mapping fire hazard areas subject to wildland fire risk. These maps should be available to planners and the public for use in reviewing projects and applying building standards which reduce the risk of fire.

Program EH-11.1b Fire Sprinkler Systems. Automatic fire sprinkler systems should be installed in all new structures and existing structures undergoing substantial remodeling, in accordance with Marin County Ordinance No. 3116, adopted on November 10, 1992.

Policy EH-11.2 **Permit Referral.** Land development and residential building permit applications should be referred to the County Fire Department or pertinent local fire district for review and recommendation.

Program EH-11.2a Building Standards. The County Community Development Agency should collaborate with the Department of Public Works and Fire Districts serving the unincorporated county to develop building standards for fire safety, in lieu of a discretionary application system. Section 4290 of the Public Resources Code requires minimum fire safety standards be applied to all new residential construction and new roadways in State Responsibility Areas. The Marin County Fire Department shall verify that all new residential construction conforms to the State requirements.

Program EH-11.2b Conditions of Approval. Recommendations made by fire authorities should be included as conditions of approval for discretionary planning permits when the Community Development Agency staff determines that these recommendations are necessary for safety reasons.

Program EH-11.2c

County Code. Requirements for referrals of discretionary planning permits to County fire officials should be specified in the County Code.

Policy EH-11.3

Mitigate Risk in New Land Divisions. Development in areas identified as having extreme fire hazard should only be allowed where adequate water for fire suppression is or can be made available. If feasible, access for residential subdivisions should be provided by more than one source. Fire trails and fuel breaks should be required when necessary. If development is to occur in extreme fire hazard areas, fire-resistant materials, clearances from structures, and landscaping with fire-resistant plants should be required. The County welcomes and encourages the Fire Department's strong recommendations regarding fire protection mitigation measures for sites and structures on all development.

Program EH-11.3a

Adequacy of Standards. The Community Development Agency and fire officials should work together to evaluate the adequacy of standards for water supply and road access to subdivisions in the Marin County Code Title 20 (County Building, Subdivisions) and Title 22 (Zoning Codes).

Program EH-11.3b

Fire Retardant Roofing. The Community Development Agency shall amend the Marin County Code to incorporate a requirement for Class A fire-retardant roofing, in accordance with the ordinance passed by the Marin County Board of Supervisors. This requirement will extend to re-roofing projects which replace more than 50% of the existing roof.

Program EH-11.3c

Brush Clearance. The Community Development Agency should amend the Marin County Code to establish uniform standards for clearance from structures, landscaping, and fire-resistant building materials (particularly pole construction), for all new construction in fire hazard areas. Removal of exotic flammable vegetation should be encouraged.

Policy EH-11.4

Fuel Breaks and Access routes. The Marin County Fire Department or other local fire protection agencies should work in concert with the Marin County Open Space District, the State Division of Forestry and the National Park Service to encourage and promote the maintenance of existing fuel breaks and emergency access routes for effective fire suppression.

Policy EH-11.5

Uniform Fire Code. The Board of Supervisors and the appropriate County agencies and all other agencies having fire protection responsibilities should continue to implement the latest Uniform Fire Code.

Program EH-11.5a

Review County Code. The Marin County Code should be periodically reviewed by the Community Development Agency, Department of Public Works, and fire officials, to insure conformance with the latest Uniform Codes.

Policy EH-11.6

Hazardous Vegetation. The County should plan for the systematic and environmentally sound reduction of hazardous vegetation, in order to reduce the buildup of old and hazardous vegetation created by effective fire suppression activities over the last 40 years.

Policy EH-11.7

Fire Safety Standards. The County should implement State of California fire safety standards for the State Responsibility Areas in a uniform manner, to insure comparable safety standards for all new construction in the county and to simplify the development review process.

Program EH-11.7a

Conformance with Fire Safety Standards. The Community Development Agency should work with fire officials to bring the Marin County Code into conformance with State Responsibility Area construction and fire safety standards.

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